Carbon Cards Challenge

Instructions

This game is played to the rules of “Happy Families” or “Quartet”.

It is a card game that is popular across Europe, with a pack of 44 cards, grouped into 11 sets of 4 (this card pack contains an option for a twelfth set for advanced students!). The CarbonKids Carbon Challenge Cards feature descriptions of issues and vocabulary related to climate change and low carbon technologies. We hope that with your help the cards will soon contain pictures too!

The idea of the game is for players to collect all 4 cards in a set. For example, to complete the “Greenhouse Gases” set you would need to collect the following 4 cards: Water Vapour/ Carbon Dioxide/ Methane and Nitrous Oxide.

1. You will need: A3 printouts of these cards, scissors, colouring pens or pencils, backing card and glue (optional), your imagination, all you have learnt about different sources of energy, emissions and low carbon technologies and cut outs of all 44 cards - well shuffled.
2. To start: in small groups or as a class, read each of the card descriptions to make sure you understand them, then try to draw an image in the blank boxes to represent the description on the card. Once you have a complete set of cards for each group, carefully cut them out (you can stick them onto cardboard to make them last longer) and shuffle them well. Deal the cards out as equally as possible to each player. Players can look at their cards but must not show them to others.
3. To play: any players who have been lucky enough to be dealt a complete set of 4 cards should put these cards face down in the centre before the game begins. The player on the dealer’s left goes first. This player (player 1) can ask any other player for a card so long as they already hold at least one card in the set. If the other player (player 2) does not have the card that player 1 has asked for, then it is player 2’s turn to ask any player for a card that they are looking for. If player 2 does have the card player 1 has asked for, they have to pass it to player 1 and player 1 can then ask another player for a different card. Once a player forms a complete set of 4 cards, they place the set face down in the centre of the group.
4. To win: the winner is the first player to get rid of all their cards.

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RENEWABLE ENERGY
Sources of energy that will not run out.

Solar energy
Thermal/electrical

Energy from the sun’s rays (solar radiation) can be converted into heat (thermal energy) and electricity (using photovoltaic cells or solar thermal power plants).

RENEWABLE ENERGY
Sources of energy that will not run out.

Wind energy
Onshore/offshore wind farms

Energy from moving air (kinetic energy) can be used to turn the blades of a wind turbine, which turn a shaft connected to an electric generator that produces electricity.

RENEWABLE ENERGY
Sources of energy that will not run out.

Water energy
Hydro/tidal/wave power

Energy from rapidly falling water, strong tides or waves can be used to spin a turbine attached to an electric generator to create electricity.

RENEWABLE ENERGY
Sources of energy that will not run out.

Geothermal and biomass energy

Heat energy from the core of the Earth (geothermal energy) can be used as hot water or steam to heat buildings and operate thermal power plants.

The chemical energy in plants and tiny organisms are converted to thermal or electrical power. Biomass can be converted into gas and transportation fuels, like bio-diesel (biomass energy).

NON-RENEWABLE ENERGY
Sources of energy that will eventually run out.

Uranium (nuclear)

Uranium is a common metal found in rocks around the world. A special type can be split apart and used to create nuclear energy. Uranium is a non-renewable form of energy but not a fossil fuel.

NON-RENEWABLE ENERGY
Sources of energy that will eventually run out.

Coal

Coal is a brown or black rock mostly made up of carbon and hydrocarbon. It is a fossil fuel because it was formed from the remains of plants buried in layers of rock for millions of years. It is easily burnt to produce heat energy, which is often used to generate electricity.

NON-RENEWABLE ENERGY
Sources of energy that will eventually run out.

Oil

A liquid called crude oil can be refined into various products, such as diesel, petrol and propane. It is a fossil fuel because it was formed from the remains of plants and tiny animals buried under layers of rock millions of years ago. Oil is mainly burnt to produce energy, but it can also be used to make products like plastic.

NON-RENEWABLE ENERGY
Sources of energy that will eventually run out.

Gas (methane – CH_4)

Methane is a colourless, odourless and tasteless gas that can be burnt to produce heat energy and then used to generate electricity. It is a fossil fuel because it was formed from the remains of plants and tiny animals buried in layers of rock millions of years ago.

GREENHOUSE GASES (GHG)
Chemicals in the atmosphere that trap some of the heat from the sun.

Water vapour (H_2O)

Water vapour is the most abundant GHG. Water vapour is part of the water cycle - the Earth is about 72% water - but it is unclear how much this GHG is affected by human activity.

GREENHOUSE GASES (GHG)
Chemicals in the atmosphere that trap some of the heat from the sun.

Carbon dioxide (CO_2)

CO_2 is the GHG that people are most concerned about due to its huge increases in atmospheric concentration in the past 200 years, largely from increased burning of fossil fuels.

GREENHOUSE GASES (GHG)
Chemicals in the atmosphere that trap some of the heat from the sun.

Methane (CH_4)

CH_4 is a less abundant but more powerful GHG than CO_2. Human activities such as landfilling, coal mining, oil and natural gas processing and farming all add CH_4 to the atmosphere.

GREENHOUSE GASES (GHG)
Chemicals in the atmosphere that trap some of the heat from the sun.

Nitrous oxide (N_2O)

N_2O is a less abundant but more powerful GHG than CH_4 and CO_2. Human activities like burning fossil fuels, using nitrogen-based fertilisers and waste management processes add N_2O to the atmosphere.

CARBON CYCLE PRODUCERS
All living things are made of carbon, it is also in the air, oceans, and in the earth.

Humans & animals

Humans & animals eat food that is full of carbon. Their bodies break this down using oxygen to produce energy and CO_2 in a process called respiration. Humans and animals then breathe the CO_2 back into the atmosphere.

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CARBON CYCLE PRODUCERS
All living things are made of carbon, it is also in the air, oceans, and in the earth.

Power stations & industrial plants

Power stations and industrial plants burn fossil fuels for energy. The carbon from the plants and tiny organisms from which the fossil fuel was originally made is released as CO_2.

Carbon Kids

CARBON CYCLE PRODUCERS
All living things are made of carbon, it is also in the air, oceans, and in the earth.

Transport

Many methods of modern transport rely on burning fossil fuels for energy, which releases lots of CO_2 into the atmosphere.

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CARBON CYCLE PRODUCERS
All living things are made of carbon, it is also in the air, oceans, and in the earth.

Deforestation

Deforestation produces CO_2 by reducing the number of CO_2 - absorbing trees. Carbon contained within those trees as CO_2 when they are burnt or left to decompose.

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CARBON CYCLE ABSORBERS
Human activity has upset the natural carbon cycle.

Trees & plants

Trees and plants are the main absorbers of CO_2. They use CO_2 and sunlight to make their own food and grow and produce oxygen, which humans and animals need to breath. This process is called photosynthesis.

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CARBON CYCLE ABSORBERS
Human activity has upset the natural carbon cycle.

Oceans

Oceans and other large stretches of cool water absorb vast quantities of carbon from the atmosphere, which algae use to grow.

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CO_2 CAPTURE
Preventing release of CO_2 from power stations and industrial plants

Pre-combustion capture

CO_2 is removed from fossil fuels before burning, leaving hydrogen gas to be burnt for electricity and pure CO_2 to be stored or used.

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CO_2 CAPTURE
Preventing release of CO_2 from power stations and industrial plants

Post-combustion capture

CO_2 is captured from the waste gases produced when fossil fuels are burnt for energy. This process is very common at a small scale in the chemical and food industries.

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CO_2 CAPTURE
Preventing release of CO_2 from power stations and industrial plants

Oxyfuel

This is similar to post-combustion technology, but fossil fuels are burnt in extra oxygen rather than air. This makes it easier to separate the CO_2 from other gases without having to use expensive chemicals.

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CO_2 CAPTURE
Preventing release of CO_2 from power stations and industrial plants

Natural gas processing

Some sources of natural gas contain lots of CO_2 that has to be removed before the gas is sold. Gas processors often release this CO_2 into the atmosphere, but more are starting to capture and permanently store the CO_2 in geological storage sites.

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CARBON CYCLE ABSORBERS
Human activity has upset the natural carbon cycle.

Earth

When plants and animals die, their remains decay and decompose and the carbon in their remains is absorbed by the Earth. This is the process that created fossil fuels millions of years ago.

Carbon Kids

CARBON CYCLE ABSORBERS
Human activity has upset the natural carbon cycle.

Atmosphere

CO_2 in the atmosphere is an essential greenhouse gas that keeps the Earth warm. But because there are now so many more CO_2 producers than absorbers, the atmosphere contains too much CO_2. This is causing climate change.

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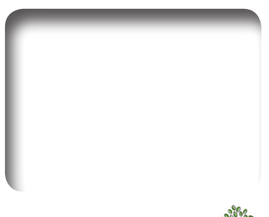
CO_2 TRANSPORT
Once captured, CO_2 is transported to a storage site.

Pipeline

The most common method of transporting large quantities of CO_2 is through pipelines. There are already millions of kilometres of pipelines around the world that transport various gases, including CO_2.



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CO_2 TRANSPORT
Once captured, CO_2 is transported to a storage site.

Ship

Shipping CO_2 is an option for moving it over long distances or in areas where pipelines are not available. Small-scale shipping of CO_2 already takes place in Europe. Softdrink producers are some of the biggest shippers of CO_2!

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CO_2 TRANSPORT
Once captured, CO_2 is transported to a storage site.

Compression

In its natural state, CO_2 is a gas. Gases take up lots of space and are not easy to transport. CO_2 is put under great pressure to turn large volumes of gas into much smaller volumes of a kind of liquid gas for transportation. This process is called compression.

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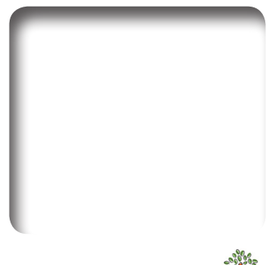
CO_2 TRANSPORT
Once captured, CO_2 is transported to a storage site.

Truck & rail

It is possible to transport small amounts of CO_2 by truck and rail. This is often the form of transport used for small test project sites.



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CO_2 STORAGE
CO_2 can be injected into rock for permanent storage.

Enhanced oil recovery

CO_2 has been injected into rock formations for more than 30 years to suck the last drops of oil from old reservoirs. By using waste CO_2 to do this job, CO_2 can be usefully recycled and eventually stored in the rock formation.

Carbon Kids

CO_2 STORAGE
CO_2 can be injected into rock for permanent storage.

Caprock

Effective CO_2 storage sites have layers of non-permeable rock, like shale, that act as a physical barrier to injected CO_2 moving back to the surface. This rock is called caprock.

Carbon Kids

CO_2 STORAGE
CO_2 can be injected into rock for permanent storage.

Porous & permeable

Effective CO_2 storage sites are made of rock that is porous (full of tiny holes) and permeable (the holes are connected enough to allow movement through the rock). This is the same kind of rock where oil and gas has been stored for millions of years.

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CO_2 STORAGE
CO_2 can be injected into rock for permanent storage.

Oil and gas or saline reservoir

Porous rocks are required to permanently store CO_2. The pores might contain some oil or gas or, more likely very salty water. Injected CO_2 will push these fluids aside and may even react with them to form stable minerals to permanently store the CO_2.

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CCS RESEARCH
More research is needed to make CCS a commercially viable, sustainable low-carbon technology.

Reducing cost

CCS requires a lot of up-front funding, and parts of the technology need to be more efficient and less expensive. The more testing and demonstration of the technology, the more costs are likely to reduce.

Carbon Kids

CCS RESEARCH
More research is needed to make CCS a commercially viable, sustainable low-carbon technology.

Reducing energy requirements

CCS technology, especially CO_2 capture, requires large amounts of energy. Lots of testing is being done to reduce the energy required for CCS to make the technology sustainable.

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ACTIONS
We all have a role to play in reducing CO_2 emissions!

Energy efficiency at home and school

Lots of small actions can make a huge difference. We should all be recycling, using energy saving light bulbs, improving building insulation, switching off appliances and trying not to waste food.

Carbon Kids

ACTIONS
We all have a role to play in reducing CO_2 emissions!

Improving energy efficiency in industry

Improving the energy efficiency of industrial processes and in power generation is essential to reduce CO_2 emissions and create more sustainable, environmentally conscious industries.

Carbon Kids

ACTIONS
We all have a role to play in reducing CO_2 emissions!

Using renewable sources of energy

Governments and organisations must work hard to improve renewable energy technologies and energy infrastructure to increase the renewable sources we can use to meet world energy demands.

Carbon Kids

ACTIONS
We all have a role to play in reducing CO_2 emissions!

Developing low carbon technologies

Fossil fuels will be part of our future energy mix, so it is really important to develop technologies - like CCS - that will allow us to deal responsibly with the CO_2 emissions they produce.

Carbon Kids

CCS RESEARCH
More research is needed to make CCS a commercially viable, sustainable low-carbon technology.

Finding good storage sites

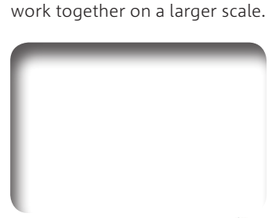
Safely storing CO_2 relies on detailed studies of potential storage sites. Lots of work is being done globally to identify suitable storage sites and share learning about identifying and monitoring CO_2 stores.

Carbon Kids

CCS RESEARCH
More research is needed to make CCS a commercially viable, sustainable low-carbon technology.

Making the technology bigger

CCS is not a 'new' technology. All the different parts of CCS have been used seperately in other industries for many years. CCS developers are working hard to take familiar technologies and make them work together on a larger scale.



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CO_2 STORAGE
Extension cards for advanced students.

Structural trapping

Injected CO_2 will first move to the top of the rock formation where it will be trapped underneath the caprock, which acts as a seal. In most sites there will be multiple layers of caprock.

Carbon Kids

CO_2 STORAGE
Extension cards for advanced students.

Residual trapping

Some injected CO_2 will get stuck in the tiny pore spaces in the rock.

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CO_2 STORAGE
Extension cards for advanced students.

Dissolution trapping

Over time, some of the injected CO_2 will dissolve slowly into the salty water in the rock pores and become trapped.

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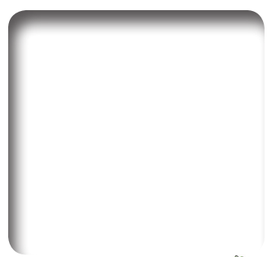
CO_2 STORAGE
Extension cards for advanced students.

Mineral trapping

The ultimate form of CO_2 trapping occurs when dissolved CO_2 reacts with the rock around it to form a mineral such as calcium carbonate.



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